REMARKS

Applicant gratefully notes that the Examiner has reopened prosecution on this application.

The application names joint inventors and the subject matter of all of the claims in the application was commonly owned at the time any inventions covered therein were made.

Claims 37-59 are pending in the application and all of the claims currently stand rejected. Specifically, Claims 37-45 and 50-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Helf in view of Harvey et al. Claims 46, 47 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Helf in view of Harvey et al., further in view of Walter. Finally, Claim 48 is rejected under 35 U.S.C. 103(a) as being unpatentable over Helf in view of Harvey et al. and Walter, further in view of McDonald. Applicant respectfully traverses.

A prima facie case of obviousness may be rebutted by either a showing that the claimed range achieves unexpected results relative to the prior art or a showing that the cited art, in any material respect, teaches away from the claimed invention.

The Helf reference teaches an interlayer that requires what is called a flexible aggregate. In the fourth paragraph of column 5 of the Helf patent states that the flexible aggregate is not hard material, but instead a soft or rubbery material. Further in the fifth paragraph of that same column, the Helf patent states that the flexible aggregate is flexible unlike hard aggregate such as sand, pebbles or rock. The sixth paragraph states that in a preferred embodiment, the flexible aggregate is

vulcanized rubber obtained from recycled tire material or reclaimed tire chippings. This is not the aggregate of the present invention.

The present invention employs the standard definition for aggregate as that term is understood in the road building industry which means hard mineral aggregate, i.e. gravel and crushed stone. Applicant has attached a reprint where this standard definition for aggregate is discussed taken from The Civil Engineering Handbook edited by W. F. Chen. Thus, Helf teaches away from the use of traditional aggregate in his invention, but instead teaches use of a flexible material which he has called flexible aggregate since it is being substituted in his invention for true, hard, traditional mineral aggregate. Use of flexible aggregate substitute would certainly alter the stability and the fatigue resistance of the mix over what would be produced with traditional non-flexible aggregate employed in the present invention.

The Examiner states that Helf teaches the addition of cross-linking agents to the binder. Helf does not teach the addition of cross-linking agents to the binder. Instead, the reference to cross-linking agents cited by the Examiner is to the cross-linking materials such as sulfur employed in making the tires. The tires are not the binder but, when ground up into tire chippings, the tires serve as the so called flexible aggregate or aggregate substitute in the mixture.

Although the prior art may teach optimization of stability and fatigue resistance for asphalt mixtures for making an interlayer for a roadway, it does so by balancing the property of stability against the competing and opposing property of fatigue resistance. Up until the present invention the stability of an asphalt

mixture and the fatigue resistance of that mixture were inversely related. This means that an increase in the stability of the mixture produced a decrease in its fatigue resistant properties and vise versa. Thus, the prior art teaches away from simultaneously increasing both stability and fatigue resistance in an asphalt mixture.

The present invention teaches increasing both the property of stability and the property of fatigue resistance at the same time and does not simply try to optimize these two competing properties. This is not taught by the prior art that was cited by the Examiner nor is it even contemplated as a possibility by the prior art. The Harvey reference is particularly pertinent to illustrate this difference between the present invention and the prior art.

Higher numbers for stability indicating more stability. Stability is determined by using the Hveem stabilometer procedure. The normal range for stability for asphalt mixtures is approximately 18 -20. Fatigue life is measured at selected strain levels. Fatigue life is measured as the number of repetitions to failure by the Flexural Beam Fatigue procedure. Higher numbers indicate higher fatigue resistance. The greater the strain level the lower the fatigue life. Also, traditionally the higher the stability the lower the fatigue life.

Page 8 of the cited Harvey reference states that stain levels in the 300-150 microstrain range producing highest fatigue life of approximately 50,000 to 500,000 repetitions. This is a significantly lower strain rate than the approximately 2000 microstrains range employed with the present invention. Figure 3.1 of the Harvey reference shows that at a strain of 150 microstrains for a 6% asphalt mixture, the top range for fatigue life is approximately 1,500,000. However in Figure 3.2 of the

Harvey reference, at a strain of 300 microstrains for the same 6% asphalt mixture, the top range for fatigue life is greatly reduced, i.e. to approximately 80,000. As shown in Figure 5.1, the stability of a 6% asphalt mixture is approximately 18 which is in the normal range of 18-20. The present invention is operating at a strain of a couple of magnitudes greater than that taught by Harvey, i.e. in the range of 2000 microstrains. At this strain, under the teaching of the Harvey patent, the fatigue life would clearly be extremely poor, probably in the range of 200. This fatigue life is well below the claims of the present invention. At a strain of approximately 2000 microstrains for a 6% asphalt mixture with a stability of 18, the present invention is achieving fatigue life in excess of 100,000. This combination of high fatigue life and high stability is certainly an unexpected result in light of the teaching found in the prior art and specifically in light of the teaching of the Harvey patent.

Further, in the second paragraph on page 2 of the Harvey reference, it states that "fatigue performance is not directly evaluated in the mix design process." A footnote on that same page states "Indirectly, fatigue performance is included if the basic philosophy of mix design is followed; i.e. as much asphalt as possible is included for good durability and fatigue performance but not so much that the load carrying capability is reduced below some minimum desired level (as defined by the Hveem Stabilometer) dependent on traffic." This clearly teaches away from the use of a direct fatigue performance test as a basis for selection of a mix design. Also, it also teaches that the basic philosophy of mix design is that stability and fatigue performance are inversely related, i.e. increasing the amount of asphalt in the mix increases the fatigue properties, but at the same time decreases the stability.

For the reasons expressed above, Applicant respectfully traverses the rejection of the pending claims. It is believed that this application is now in condition for allowance, and such action is earnestly solicited.

The Commissioner is hereby authorized to charge any additional fees to the deposit account of the undersigned, No. 13-0470.

Respectfully submitted,

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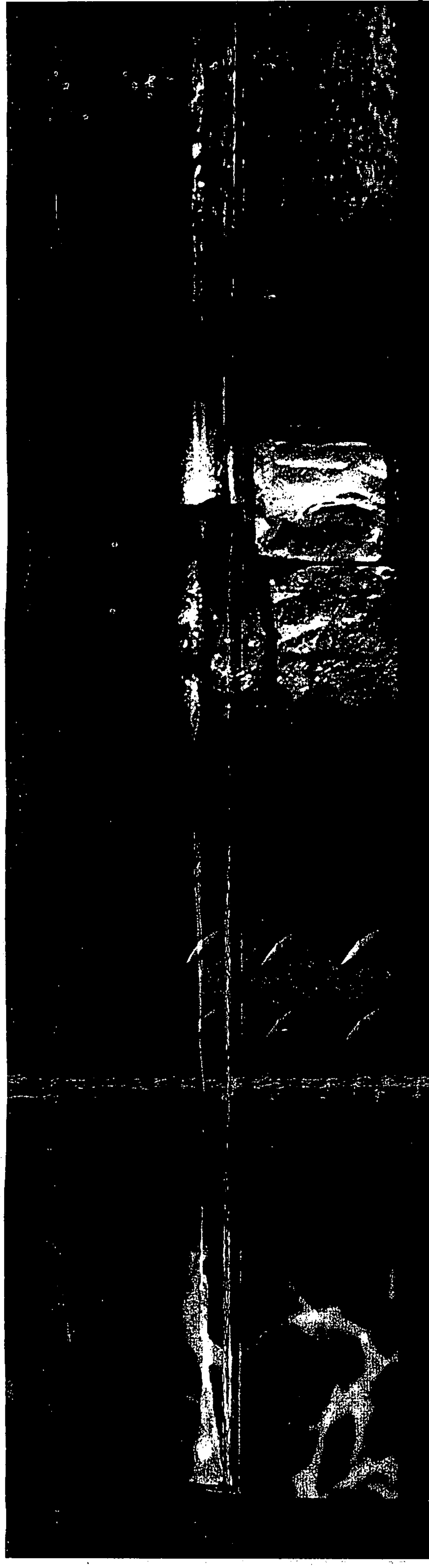

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Aggregates

By far the largest amount of aggregate used in concrete is mineral aggregate—gravel and crushed stone. Good concrete can be made with either. A local supply is almost always used, since the shipment of large amounts of heavy material over long distances is prohibitively expensive. Aggregate differs in quality, and in some locations high-quality aggregate is now in short supply. Sometimes nonmineral aggregates are used. These are manufactured, sometimes waste, materials. Chief among them is crushed blast furnace slag that has been slowly air-cooled.

Concrete aggregates are divided into fine and coarse, based on retention on the 4.75 mm (No. 4) sieve. Fine aggregate obtained from a natural supply is called sand. A mortar is a cementitious mixture without coarse aggregate. Aggregates are also categorized into normal-weight, lightweight, and heavyweight aggregates. Lightweight aggregates are used to make lightweight concrete, where the dead weight of the structure is an important design parameter. Heavyweight aggregates are used for radiation-shielding concrete.

The civil engineer is usually concerned with the physical, rather than the chemical or mineralogical, properties of aggregates. The main exception is the alkali–aggregate reaction, which is treated in the chapter on durability of concrete. The physical properties of most interest are the specific gravity, **porosity** and voids, and particle size distribution, or grading.

Concrete aggregates are almost always porous materials, and an aggregation of such particles has two kinds of spaces. The intraparticle spaces are called the pores, and the interparticle spaces are called the voids, although sometimes the terms are, unfortunately, used interchangeably. The pores, along with the nature of the solids, determine the various specific gravities of the individual pieces; they are functions of the kind of substance and not of the nature of its aggregation or packing. The voids determine the specific gravity, or unit weight, of a packing. Both properties are important to mix design.

The weight of a packing is termed the *dry-rodded unit weight* and is determined according to ASTM C 29. The value is the weight of unit volume of the dry packing that has been rodded into a container. Such a value includes the voids as part of the volume in question.

When only the pores, and not the voids, are considered, the total volume of pores and solids (i.e., that inside the "skin" of the individual piece of aggregate) is called the bulk volume. The mass of unit dry bulk volume is the bulk density. If the pores contain water, the mass of unit wet bulk volume is the bulk-saturated surface-dry density. These two parameters, calculated as the respective specific gravities, are determined according to ASTM C 127.

The weight of water absorbed into the pores by unit weight of dry solid is its **absorption,** also determined by C 127. The volume of water divided by that of the pores (i.e., the degree to which they are full of water) is called the degree of saturation, or simply the saturation. It and the absorption are frequently quoted as a percentage.

The particle size distribution of the pieces of an aggregate is termed the **grading.** Gradings are continuous if no sizes are missing between the largest and smallest; if they are, it is a *gap* grading. If the particles are comparatively large, the grading is *coarse*; if small, it is *fine*. If the size range between largest and smallest is comparatively large, the grading is *long;* if not, it is *short*. The shortest grading is *single-size,* when everything is the same.

With aggregates, the size is determined by the sieve openings that the piece will, and will not, pass. So a group of particles is said to pass such-and-such a sieve and be retained on its smaller neighbor in the nest. Sieve analysis is performed according to ASTM C 136. If the sample is a fine aggregate, the sizes of the openings of the sieves in the nest differ from each other by a factor of two. The standard set goes from 4.75 mm (No. 4) to 150 μm (No. 100) and thus establishes five sizes of material. For coarse aggregates, the two factor is too large, and intermediate sizes are used up to the largest, the so-called D_{max}.

Sieve analysis is usually shown as a cumulative (integral) distribution curve, plotting the percentage passing a given sieve against the logarithm of its size. The spaces between the increments on the abscissa are then equal, owing to the two factor between sieve sizes.